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(54) IMPROVEMENTS IN OR RELATING TO HIGH TEMPERATURE MORTARS

SPECIFICATION NO. 1,225,629

INVENTOR: ANNA VICTORIA MORSANYI

By a direction given under Section 17 (1) of the Patents Act 1949 this application proceeded in the name of PILKINGTON BROTHERS LIMITED, a Company incorporated under the laws of Great Britain, of 201-211 Martins Bank Building, Water Street, Liverpool 2, Lancashire.

THE PATENT OFFICE

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The mortars commonly used for cementing silica brick for use at high temperatures, as for example in glass melting furnaces, generally include a high proportion of the order of 90% to 97% by weight of quartz of varying particle size distribution. Quartz is a low temperature form of silica which undergoes crystallographic modification at high temperatures (exceeding 870°C) accompanied by a permanent expansion. This linear permanent expansion of mortars is usually of the order of 2% to 5%.

The silica brick to which such mortar is applied contains fired silica, that is to say, high temperature modifications of silica. The heating of such brick to high temperatures, of the order of 1500°C, is therefore, accompanied by little or no crystallographic change which involves permanent expansion, the only expansion being a reversible linear thermal expansion of 1% to 1.4%. If therefore, the conventional silica mortar is employed in jointing such brick, differential expansion of the brick and the mortar occurs at high temperatures, resulting in relative movement and some detachment of the motor from the brick with the formation of narrow fissures at the interfaces of the brick and mortar. Such discontinuities are particularly undesirable in the brick superstructure lining of a glass furnace, as slagging agents can penetrate the fissures, corroding the silica bricks behind the hot surface thereof. It is a main object of the present the resulting reversible thermal expansion can be arranged to be of the same order as that of the material to be cemented. As a result the bond formed by the mortar is improved and remains substantially tight and impenetrable at elevated temperatures.

Preferably more than 60% by weight of the motar is passed by a 300 B.S.S. mesh sieve.

The mortar undergoes a reversible thermal expansion of the order of 1% when heated to approximately 1500°C.

The mortar preferably includes at least 0.2% by weight of a low temperature plasticising agent, such, for example, as a water-soluble methyl cellulose. Molasses or dextrine may alternatively be included as a plasticising agent.

The powdered cristobalite and/or tridymite may, according to one embodiment of the invention, comprise crushed fired silica brick. As is known in the art, crushed fired silica brick normally includes a small proportion of combined calcium oxide.

Conventional mortar additives, such as sodium silicate, boric oxide and lime, may be included in the mortar according to the invention.

In another modification of the invention the mortar instead of being made from crushed fired silica brick, is made by heating quartz to a suitable temperature exceeding 870°C (preferably of the order of 1500°C) to form

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(54) IMPROVEMENTS IN OR RELATING TO HIGH TEMPERATURE MORTARS

(71) We, PILKINGTON BROTHERS LIMITED, a Company incorporated under the laws of Great Britain, of 201—211 Martins Bank Building, Water Street, Liverpool 2, Lancashire, England and ANNA VICTORIA MORSANYI, a British Subject, of 5 Carter Avenue, Rainford, Lancashire, England, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to mortars for high temperature applications.

The mortars commonly used for cementing silica brick for use at high temperatures, as for example in glass melting furnaces, generally include a high proportion of the order of 90% to 97% by weight of quartz of varying particle size distribution. Quartz is a low temperature form of silica which undergoes crystallographic modification at high temperatures (exceeding 870°C) accompanied by a permanent expansion. This linear permanent expansion of mortars is usually of the order of 2% to 5%.

The silica brick to which such mortar is applied contains fired silica, that is to say, high temperature modifications of silica. The heating of such brick to high temperatures, of the order of 1500°C, is therefore, accompanied by little or no crystallographic change which involves permanent expansion, the only expansion being a reversible linear thermal expansion of 1% to 1.4%. If therefore, the conventional silica mortar is employed in jointing such brick, differential expansion of the brick and the mortar occurs at high temperatures, resulting in relative movement and some detachment of the motor from the brick with the formation of narrow fissures at the interfaces of the brick and mortar. Such discontinuities are particularly undesirable in the brick superstructure lining of a glass furnace, as slagging agents can penetrate the fissures, corroding the silica bricks behind the hot surface thereof. It is a main object of the present invention to provide a mortar which is less prone to this undesirable effect, in use at high temperatures.

According to the present invention there is provided a mortar suitable for cementing material containing fired silica, said mortar including pulverised, ground, or crushed cristobalite or tridymite, or a mixture of cristobalite and tridymite, and having a particle size distribution such that more than 55% by weight of the mortar is passed by a 300 B.S.S. mesh sieve.

By using the high temperature modifications of silica as a constituent of the mortar, the resulting reversible thermal expansion can be arranged to be of the same order as that of the material to be cemented. As a result the bond formed by the mortar is improved and remains substantially tight and impenetrable at elevated temperatures.

Preferably more than 60% by weight of the motar is passed by a 300 B.S.S. mesh sieve.

The mortar undergoes a reversible thermal expansion of the order of 1% when heated to approximately 1500°C.

The mortar preferably includes at least 0.2% by weight of a low temperature plasticising agent, such, for example, as a water-soluble methyl cellulose. Molasses or dextrine may alternatively be included as a plasticising agent.

The powdered cristobalite and/or tridymite may, according to one embodiment of the invention, comprise crushed fired silica brick. As is known in the art, crushed fired silica brick normally includes a small proportion of combined calcium oxide.

Conventional mortar additives, such as sodium silicate, boric oxide and lime, may be included in the mortar according to the invention.

In another modification of the invention the mortar instead of being made from crushed fired silica brick, is made by heating quartz to a suitable temperature exceeding 870°C (preferably of the order of 1500°C) to form

the cristobalite and/or tridymite modifications and, after cooling, crushing the said cristobalite and/or tridymite. Preferably between 2% and 3% by weight of hydrated lime is mixed with the crushed cristobalite and/or tridymite after said cooling thereof. This produces a mortar having approximately the same composition as a normal silica brick.

Further according to the invention proportions of sodium silicate and/or boric oxide may be added to the mortar.

The invention also includes a cement formed with a mortar as defined hereinabove. A wet cement formed with mortar according to the invention preferably includes 20% to 35% by weight of water.

In order that the invention may be more easily understood, some typical examples of mortars and methods of manufacturing mortars according to the invention are given below.

Example I

A mortar mix is formed by crushing silica brick. The silica brick is of the conventional type and has been fired to approximately 1450°C at which temperature the irreversible crystallographic change to the high temperature modifications of silica, cristobalite or tridymite with the accompanying expansion, takes place rapidly and substantially completely. The unfired brick also contains a small amount of calcium oxide; this, on firing, combines with the silica to form calcium silicate, which acts as a binding agent.

One cwt. of this fired silica brick after crushing was sieved by passing it through an 85 B.S.S. sieve. The resulting particle size distribution, in percentages by weight, was as follows:—

0.8% retained by 100 B.S.S. mesh sieve.
18.4% retained by 200 B.S.S. mesh sieve.
17.4% retained by 300 B.S.S. mesh sieve.
63.4% passed by 300 B.S.S. mesh sieve.

The crushed fired silica brick is mixed with 0.3% to 1.2% by weight of a low temperature plasticiser to make the mortar workable during application. The plasticiser is burned off when the mortar is heated after application. The plasticiser in this particular example comprises 12 oz. of "METHOFAS" (Trade Mark) type PM 125 plasticiser. Any suitable water-soluble methyl cellulose plasticiser could, however, be used.

Example II

A mortar mix is made by crushing fired silica brick as described in Example I. The resulting powdered cristobalite or tridymite is mixed with a plasticiser comprising 3% by weight of molasses.

Example III

Fired silica brick is ground and sieved as in Examples I and II the particle size distribution, in percentages by weight, being in this example as follows:

0.4% passed by: 60* retained by: 72*
0.8% passed by: 72* retained by: 85*
1.3% passed by: 85* retained by: 100*
1.2% passed by: 100* retained by: 120*
15.4% passed by: 120* retained by: 170*
10.1% passed by: 170* retained by: 240*
14.1% passed by: 240* retained by: 300*
56.6% passed by: 300*

* The numbers quoted in each case refer to the B.S.S. mesh of the respective sieve.

A plasticiser was added as in Example I or in Example II.

Example IV

Quartz is fired to a temperature of approximately 1500°C to form the high temperature cristobalite or tridymite modifications thereof, or both. The resulting material is cooled, and ground to a powder having a size distribution suitable for jointing and troweling such that at least 55% by weight of the material passes through a 300 B.S.S. mesh sieve, some 2% to 3% by weight of hydrated lime is then added to the powdered cristobalite and/or tridymite, together with a suitable plasticiser, which may comprise a cellulose plasticiser as in Example I or molasses, as in Example II.

The mortars described in the above examples have a particle size distribution which makes them suitable for trowelling when mixed with 20% to 35% by weight water to form a wet cement.

On hardening the mortar cement has a thermal expansion which is compatible with that of silica brick, specifically 1.0% to 1.4% over the temperature range 20°C to 1500°C. The resulting porosity of the mortar when fired at 1500°C is between 20% and 52% and its refractoriness is between 32 and 33 Pyrometric Cone Equivalent.

WHAT WE CLAIM IS:—

1. A mortar suitable for cementing material containing fired silica, said mortar including pulverised, ground, or crushed cristobalite or tridymite, or a mixture of cristobalite and tridymite, and having a particle size distribution such that more than 55% by weight of the mortar is passed by a 300 B.S.S. mesh sieve.

2. A mortar as claimed in Claim 1, in which approximately 60% by weight of the mortar is passed by a 300 B.S.S. mesh sieve.

3. A mortar as claimed in Claim 1 or Claim 2, which undergoes a reversible thermal expansion of about 1% when heated to approximately 1500°C.

4. A mortar as claimed in any of Claims 1 to 3, including at least 0.2% by weight of a low temperature plasticising agent.

5. A mortar as claimed in Claim 4, in which the plasticising agent is a water-soluble methyl cellulose.

6. A mortar as claimed in Claim 4, in which the plasticising agent is molasses or dextrine.

7. A mortar as claimed in any one of the preceding claims, in which the powdered cristobalite and/or tridymite comprises crushed fired silica brick.

8. A mortar as claimed in any of Claims 1 to 7, including added proportions of sodium silicate and/or boric oxide.

9. A method of making a mortar as claimed in any of Claims 1 to 6, in which the powdered cristobalite and/or tridymite is formed by heating quartz to a temperature exceeding 870°C and, after cooling, crushing the cristobalite and/or tridymite so formed.

10. A method as claimed in Claim 9, in which 2% to 3% by weight of hydrated lime is mixed with the powdered cristobalite and/or tridymite after the cooling thereof.

11. A mortar for cementing material containing fired silica, substantially as herein described in any of Examples I to IV.

12. A wet cement mix comprising mortar as claimed in any of Claims 1 to 8, or Claim 11 mixed with 20% to 35% by weight of water.

13. A method of making a mortar suitable for cementing material containing fired silica, substantially as herein described in any one of Examples I to IV.

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